FAIR Highway Networks: A New Approach to Eliminate Congestion on Metropolitan Freeways

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Abstract:

Pending Federal transportation reauthorization legislation proposes to increase the flexibility for States and local governments to use road pricing with electronic toll collection to reduce high levels of congestion and improve air quality in Clean Air Act non-attainment areas. This article presents an innovative and low-cost road pricing strategy that could make great strides in achieving these national, State and local goals. Known as "FAIR Highway Networks," the strategy converts the existing freeway network *during peak periods only* into a premium-service free-flowing freeway network that provides new fast, frequent and inexpensive bus service; free premium service for carpools; and premium service for single-occupant vehicles paying a toll which varies to manage demand and keep the freeway congestion-free. A FAIR Highway Network will be self-financing and provide significant net social benefits. Surpluses may also be available to address new transportation capacity needs in growing areas. While public acceptability is a major hurdle, FAIR Highway Networks can gain support from stakeholders and political leaders if its benefits are carefully explained, and if a pilot project is implemented on a small scale to demonstrate its effectiveness and operational feasibility.

Keywords: Road pricing, transportation demand management, transportation financing, freeway operations management, road user fees

1.0 FEDERAL LEGISLATIVE INITIATIVES ON ROAD PRICING

Federal, State and local government interest in road pricing as a congestion management tool has been growing over the past few years. The Bush Administration's Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2003 (SAFETEA) proposes to allow tolling of any Federal network component -- existing or new -- if the reason is to manage congestion or improve air quality. Additionally, SAFETEA would permit conversion of HOV lanes to *high occupancy toll* lanes or HOT lanes that allow single occupant vehicles to access the limited-use facilities as long as they pay a toll. Tolls are required to vary by time of day to ensure that free-flowing traffic conditions are maintained, and excess revenues must be used for Title 23 purposes. This allows use of surplus revenues for transit capital projects, but not for transit operations. An agreement is required that identifies congestion or air quality problems, goals and performance measures.

The House reauthorization bill, H.R. 3550, eliminates current opportunities available to States under the Value Pricing Pilot Program to use variable pricing to reduce congestion. It limits use of tolls to new highway capacity only, and requires that toll revenues be dedicated to pay for new capacity costs and that tolls be removed after these costs are paid for. Senate bill S.1072 is similar to the Administration's proposals, but broadens permissible uses of excess revenues to include Title 49 purposes, allowing use of revenues for transit operations. The Senate provisions give States and local governments broad flexibility to implement variable pricing on the Interstate Highway System in order to manage congestion. State and local governments are generally more responsive to the local citizenry than is the Federal government.

2.0 ROAD PRICING AS A CONGESTION MANAGEMENT TOOL

Freeway bottlenecks are the prime source of recurring congestion on freeway networks in major metropolitan areas. Freeway bottlenecks include mainline capacity shortfalls, interchange bottlenecks, and weave and merge friction at freeway entrance and exit ramps (1). Recent research suggests that eliminating these bottlenecks can result in eliminating recurring congestion as well as increasing vehicle throughput by as much as 50 percent.

Chen and Varaiya, in their article entitled "The Freeway Congestion Paradox," (2) demonstrated that, once freeway vehicle density (measured in vehicles per mile) exceeds a certain critical number, both vehicle speed and vehicle flow (measured in vehicles per hour) drop precipitously. They have demonstrated the phenomenon with actual data from a section of westbound I-10 in Los Angeles. Until 5:10 am, a flow of 2,100 vehicles per lane per hour is maintained, at a speed of 58 mph. As density increases after 5:10 am, speed steadily drops, until at 7:00 am speed is a stop-and-go 15 mph, and flow decreases to 1,300 vehicles per lane per hour. Even though demand on I-10 starts to decrease after 8:00 am, the freeway does not recover its full efficiency until 11:30 am, because queued vehicles from previous hours keep vehicle density high. At these high densities, the freeway is kept in "breakdown" flow condition throughout the morning hours. Flow randomly fluctuates between 1,300 vehicles per lane per hour and 2,000 vehicles per lane per hour. Speeds randomly fluctuate between 15 mph and 30 mph.

Varaiya (3) evaluated ramp metering as a way to maintain freeway throughput and free flowing travel speeds. Ramp metering keeps excess vehicles from entering the freeway when critical vehicle densities are being approached. In an analysis of the Los Angeles freeway system, Varaiya estimated that a system wide ramp metering strategy could reduce annual congestion delay from 75 million vehicle hours to 25 million vehicle hours. The analysis assumed that no motorist would choose alternate routes to avoid ramp delays and thus exacerbate existing arterial congestion; also, the analysis did not account for possible delays to motorists on arterial streets resulting from queuing back-ups at freeway entrance ramps. Varaiya's analysis shows that, while ramp metering accomplishes much, at least a third of freeway delay remains, even if additional delays to arterial motorists are ignored.

Road pricing, on the other hand, accomplishes the objective of freeway efficiency *without* ramp delays, i.e., all freeway delay is eliminated. Essentially, a "price" in the form of a variable toll dissuades motorists from queuing up to use a freeway approaching critical density and induces them to shift to carpooling and transit use. They may also shift their route or time of travel, or choose to forego the trip entirely. Solo-drivers who arrive when demand is high pay for the guaranteed congestion-free service electronically. A ramp metering strategy, on the other hand, would have motorists "pay" for freeway access with ramp delay time. Time wasted at ramp meters cannot be regained – it is gone forever, an utter waste of a scarce resource. With pricing there is no waste of either time or money, because toll revenue can be "recycled" to provide other public benefits such as transit fare subsidies, or returned to taxpayers in the form of tax reductions.

3.0 THE FAIR HIGHWAY NETWORKS CONCEPT

Potential changes in Federal legislation and burgeoning metropolitan freeway congestion are increasing the interest of State and local governments in innovative road pricing concepts. One such strategy is the "Fast and Intertwined Regular (FAIR)" Highway Network concept (4), an innovative and relatively low-cost pricing strategy that has been developed to eliminate existing congestion on freeway networks in metropolitan areas. The concept evolved from the "FAIR *Lanes*" concept, which would involve separating congested freeway lanes into two sections—fast lanes and regular lanes. Under the FAIR lanes concept, fast lanes normally would include two lanes in each direction and would be tolled electronically, with tolls set in real time to ensure that demand is kept at a level that allows traffic to move at the maximum allowable free-flow speed. Users of regular lanes still would face congested conditions but would be eligible to receive credits if their vehicles have electronic transponders. The credits would be a form of compensation for giving up the right to use the existing lane converted to a fast lane.

The FAIR Highway Network concept is more ambitious than the FAIR Lanes concept, comprising three key features:

(1) Conversion of *all lanes* of the existing freeway network *during peak periods only* into a premium-service free-flowing freeway network that provides new fast, frequent and inexpensive bus service; free premium service for carpools; and premium service for single-occupant vehicles paying a charge which varies to manage demand and keep the freeway congestion-free;
(2) An intertwined network of improved free arterial routes, including management and operations improvements; and
(3) Credits or refunds of peak charges for low-income commuters to address equity impacts and reduce the incentive for them to divert to an alternative free route.

A FAIR Highway Network does not necessarily entail construction of new lanes on the freeway mainline. It generally needs only existing physical freeway rights-of-way and infrastructure. Some new construction will be needed to mount new electronic equipment for toll collection and for management and operations of the freeway and arterial networks, including traveler information; for new parking facilities; and for direct access ramps to and from these facilities for those choosing to park and ride in a carpool or in an express bus. Due to the limited amount of new construction, an entire metropolitan FAIR Highway Network may be put in place in a relatively short period of time, without the need for time-consuming and lengthy environmental review processes. A FAIR Highway Network may also be self-financing and generate surplus revenue to help pay for expansion of the transportation network to address capacity needs at the most severe bottlenecks and to accommodate growth in population, jobs and travel. In fact, the magnitude of the motorist's willingness-to-pay, as expressed through the market clearing peak period charges on various freeway segments, would provide a clear indication of the locations of the most pressing expansion needs.

FAIR Highway Networks would operate in peak periods only. There would be no change in freeway operating policy outside the peak periods. Free service would be provided to all vehicles outside the peak periods, just as it is currently. The freeway network would operate in peak periods as if it were a system reserved for free premium service to carpool vehicles and transit, somewhat like the existing peak period operation of I-66 inside the Capital Beltway in Washington, DC. However, in addition (unlike I-66), solo drivers would be permitted to use the system with payment of a variable peak service charge. Solo drivers who wish to travel when demand is high may choose to pay for the improved service, or shift to other travel modes (i.e., enhanced transit or carpooling), to other times of the day, or to other (free) arterial routes.

Low-income commuters are the ones most likely to divert to arterial routes to avoid paying the peak charges. This is because, although their value of time is likely to be high relative to their wage rates, it is likely to be lower than the peak charges more often than it is for higher-income commuters. To reduce the inducement for traffic diversion, as well as to address concerns about equity towards these commuters, they would be offered credits (or refunds) to help them pay for out-of-pocket costs they may incur for peak period charges. Many local governments already have such means-tested programs for school lunches and property tax relief.

Relatively few vehicles need be removed from the traffic stream to have a substantial impact on congestion. For example, Wachs (5) observes that traffic in Boston is surprisingly free flowing on a Jewish holiday; the same phenomenon occurs in California on days when only California state employees are off work due to a state holiday. This suggests that we need to induce only a few motorists to change their peak period travel behavior to substantially reduce congestion. To keep these (or new) motorists from returning to the highways in order to take advantage of the improved travel times after congestion is relieved, we need a variable pricing mechanism to keep demand from rising due to the reduced travel time "price."

A key feature of FAIR Highway Networks is the inducement to shift from solo driving provided by inexpensive, high quality transit service, or incentives to share the ride with someone else. To maximize the potential for change in travel behavior, complementary strategies may also be used, such as requirements for employers to provide their employees with an option to "cash out" parking currently provided to them for free; tax incentives for businesses to locate at high-density employment sites; and incentives for developers to invest in transit oriented development in residential areas.

Due to the significant travel time savings from the avoidance of traffic flow breakdowns, the value of time saved would exceed by far the peak service charges, and the overall time plus money cost (i.e., the "generalized" cost) of solo driving would fall. However, an inducement to shift from solo driving is also provided because inexpensive express transit service and carpooling are made even more attractive with features such as convenient park-and-ride facilities. As David Lewis (6) posits, high quality transit service reduces congestion on *all* modes in a congested corridor. High quality and reliable transit service is like a “scanner line” in a grocery store that guarantees service in five minutes. If the other “human service” lines exceed five minutes, shoppers will gravitate towards the guaranteed five minute line, so that the other lines also never exceed by very much the service time of five minutes. According to Lewis, with reliable transit service, automobile travel times will likewise be kept down to the service times provided by transit. This phenomenon is known as “Mogridge-Lewis convergence,” since it was originally posited by the late Martin Mogridge, a U.K. operations analyst. By introducing new, reliable transit service on a system wide basis, FAIR Highway Networks will keep travel times down for the auto mode across the entire freeway and arterial networks.

4.0 FAIR HIGHWAY NETWORK OPERATIONS

Operation of a FAIR Highway Network may best be explained using the example of I-10 in Los Angeles discussed above. With a FAIR Highway Network in place, westbound motorists after 5:10 am would see a variable message sign saying:

“PEAK CHARGES IN EFFECT
10 CENTS/MI, HOV 2+ FREE
SLUG LINE, TRANSIT, PARKING
AT NEXT EXIT”

HOV2+ is the shorthand term commonly used to refer to high-occupancy vehicles (HOV) with two or more persons. A slug is an informal carpooler who waits to be picked up at a designated location by a solo driver who wishes to avail of free use of HOV lanes by giving a free ride to the required number of passengers. This form of carpooling, called “casual carpooling” or “dynamic ridesharing,” is practiced in the Washington, DC, San Francisco and Houston metropolitan areas. A solo driver would understand from the sign that he or she has several options:

(1) *Stay on the freeway and pay the designated toll* at highway speed using a previously acquired transponder. Transponders are currently available in the form of vehicle stickers for as little as $5.00 and can be dispensed from ATM-like vending machines. There would be no need to stop or even slow down – open road tolling would be employed. Even vehicles without a compatible transponder would not need to stop. License plate recognition technology would be used to identify the vehicle owner, and he or she would be sent a bill in the mail. An administrative charge would be added to the bill to cover expenses. This system is currently employed on the Highway 407 toll road in Toronto, Canada (7).

(2) *Park and use express transit service, or get a free ride in a carpool* by joining a slug line at the next exit. Special park-and-ride lots with direct access to the freeway would include express bus stations so that solo drivers could park and take the bus, or join an informal carpool as a "slug."

(3) *Drive on the freeway for free after by picking up a passenger from the slug line*. Of course, regular commuters could form a conventional carpool, so that stopping to pick up a passenger (or waiting to be picked up by a solo driver) would be necessary only on those days that a conventional carpool was missing a passenger for any reason (e.g., vacation).

(4) *Exit the freeway and take an alternate toll-free arterial route.* In travel corridors with good transit service or carpool incentives, the number of commuters making this choice can be kept to the minimum. Low-income commuters are discouraged from using this alternative to save money by providing them with credits or refunds based on income level. Investments in advanced arterial signal systems will permit accommodation of traffic diversions (if any) without exacerbating arterial congestion. Due to Mogridge-Lewis convergence, diversions from arterials to the freeway are likely to exceed any diversions from the freeway to arterials.

A motorist with a passenger (i.e., in a two-person carpool) would simply continue to drive on the freeway. Special HOV access lanes would be provided near freeway entrance ramps, in association with park-and-ride facilities. Carpools going through these lanes would have their vehicle transponder ID numbers recorded, so that zero charges would apply to them at all charging points on the freeway. Video surveillance technology, supplemented by police enforcement if necessary, would be used at HOV access ramps to ensure against use of HOV access lanes by solo drivers. The transponder readers and video surveillance cameras on the freeway would be hung from existing overpasses or overhead sign gantries wherever possible to avoid the need for expensive new gantries. The charges would vary dynamically, as on the I-15 express lanes in San Diego (8). The charge during any six-minute interval would be no higher than that necessary to create the right balance between demand for freeway use and critical vehicle density, in order to avoid traffic flow breakdowns.

5.0 ECONOMIC EFFICIENCY AND FINANCIAL FEASIBILITY

Costs for a typical regional FAIR Highway Network have been estimated based on the freeway network in the Washington, DC metropolitan area (4). The freeway network would employ open road tolling, with toll charging points located at approximately 3-mile intervals. New express bus service would be introduced during peak periods. Fares would be $1.00 per trip and free parking would be provided at transit stations. Each park-and-ride lot would provide for HOV identification for vehicles with two or more occupants, so that they would not be billed when their transponders were identified on the freeway. Transponder readers and surveillance equipment for this purpose would be provided in HOV identification zones. Adaptive signal control with advanced signal systems would be implemented region-wide. Total estimated annualized costs to transportation agencies for all key components of a typical FAIR Highway Network were estimated as follows (4):

Toll/ credit operations	$ 100.0 million
Express bus service	$ 115.5 million
Park-and-ride facilities	$ 46.4 million
Signal systems	$ 10.0 million
Total system cost	$271.9 million

Benefits from a FAIR Highway Network include benefits to travelers (such as travel time and vehicle operation cost savings) as well as reductions in external costs, including reductions in air pollution, noise and crash costs borne by society as a whole. Table 1 below provides a summary of estimated annualized system wide costs, revenues and benefits from a typical FAIR Highway Network (4). The "Low" scenario assumes an average base case travel speed on congested freeway segments of 30 mph in peak periods. The "High" scenario reflects a more severely congested metropolitan area where travel speed on congested freeway segments averages 20 mph. The comparison of system wide benefits and costs suggests that a cost-benefit ratio in excess of 2.0 will be achieved even in less congested metropolitan areas, while more severely congested metropolitan areas (such as Washington, DC) may see benefit-cost ratios as high as 5.0.

TABLE 1. SUMMARY OF COSTS, BENEFITS AND REVENUES (Million dollars annually)

	Low	**High**
Annualized costs	$271.9	$271.9
Annual social benefits	$703.8	$1,383.5
Net annual benefits	$431.6	$1,111.3
Annual revenues	$290.3	$580.6
Benefit-cost ratio	2.6	5.1
Excess of revenues over costs	$18.4	$ 308.7

A comparison of system wide revenues (after accounting for low-income credits) with system wide costs suggests that annual revenues will exceed annualized costs by about $18 million in moderately congested areas, and by over $300 million in severely congested areas. A $300 million annual surplus could support a $3 billion bond program and allow construction of as many as 375 new lane miles at an average cost of $8 million per lane mile (9).

6.0 GAINING PUBLIC AND STAKEHOLDER ACCEPTANCE

Introducing a FAIR Highway Network strategy to the public will be challenging. Gaining public acceptance of road pricing strategies requires many years of effort in public education and debate. For example, London's congestion charging scheme implemented in February 2003 was first proposed in the Smeed Report in the early sixties. In the U.S., High-Occupancy Toll (HOT) lanes are only now beginning to experience public and political acceptance in a few states, even though pilot projects have been operational in Southern California since late 1995 and in Houston since 1998. Explaining the benefits of FAIR Highway Networks to the public and to stakeholder groups will require considerably more effort than explaining the benefits of HOT lanes. However, in some respects, the case for FAIR Highway Networks may be more compelling. The marketing strategy will need to focus on a *package* of benefits to the traveling public that will increase their transportation choices. Benefits that could be highlighted include:

New and better transportation options:

- *New fast, frequent and inexpensive bus service* that will not be stuck in traffic, unlike the existing services the public is familiar with.
- *A new HOV 2+ system* providing guaranteed premium service across the whole freeway network, not just on a few freeway segments, with supporting park-and-ride facilities and slug lines.
- *Guaranteed premium service freeway lanes* for a larger number of motorists than with HOT lanes, and for a much more affordable price, since supply (i.e., number of available lanes) is much greater.

New user-based funding for transportation improvements:

- *Improved transportation system operations.* Revenues from peak charges will ensure stable funding for advanced system operations throughout the network, including arterial signal optimization, traveler information, emergency services, and other Intelligent Transportation System strategies to keep arterial systems flowing efficiently.

- *Increased investment in transportation infrastructure.* Revenues from peak charges will ensure stable funding for transportation capacity improvements, including not only freeway improvements, but also arterial intersection improvements, bikeways and pedestrian facilities.

Safeguards to Ensure Social Equity:

- Low-income motorists will have equal access to premium freeway services, and will have more and better transportation choices.
- Those who share the ride will pay nothing.
- Solo drivers will get time savings and travel time reliability benefits whose value exceeds the cost of the charges they pay. A guarantee will be provided to solo drivers that NO charges will be made to their accounts if they do not get premium service at free flow travel speeds.

A diverse range of transportation advocacy groups may potentially provide support for the concept and assist in outreach to the public. Interest groups with a potential stake in the outcomes from FAIR Highway Networks are discussed below.

Transit Interests: With FAIR Highway Networks, Bus Rapid Transit (BRT) network development will get a jump-start. A FAIR Highway Network would allow a BRT Network to be implemented much sooner and at lower cost. A network of the type proposed by Poole and Orski (10) could take as many as 20 years to complete and generate full benefits for BRT, and would cost much more due to the added costs for construction of direct access ramps that would be needed. Moreover, capital and operating costs for buses in the Poole-Orski proposal are unfunded, whereas a FAIR Highway Network will provide a funding source for both capital and operating costs.

Trucking Interests: Unlike HOT networks, financial feasibility of FAIR Highway Networks does not depend on keeping congestion levels high on the regular lanes. Service charges are only applied in peak periods, and are relatively low because "supply" of premium service road space is larger. An advantage of FAIR Highway Networks over HOV and HOT networks is that trucks are not excluded from the free-flowing lanes. Fuel consumption per minute of delay on a freeway designed for 65 mph speeds amounts to 0.328 gallons for 2-axle single unit trucks, 0.447 gallons for 3-axle single unit trucks, and 0.578 gallons for combination vehicles (11). On a severely congested freeway, with speeds averaging 20 mph, delays amount to about 2 minutes per mile. Assuming a fuel cost of $1.50 per gallon, fuel cost savings per mile on a FAIR Highway Network for the three categories of trucks amount to $0.98, $1.34 and $1.73 respectively.

However, average peak charges per mile are estimated to be $0.14 per vehicle (4). Thus trucks that have to travel during peak periods would see huge monetary savings and an increase in profits. Trucks that travel during off-peak would not be charged tolls, and would see no change in their operation costs.

Auto interests: Success of HOV and HOT lanes *depends* on continued congestion in the remaining lanes. A commuter's motivation to carpool in HOV lanes or a driver's willingness to pay on HOT lanes depends on amount of delay in the regular lanes. Thus, HOV and HOT networks must "ensure" that congestion continues on the regular freeway network, if they are to be successful. FAIR Highway Networks, on the other hand, will eliminate *all* congestion on the freeway, reducing the drain on motorists' time and vehicle operating costs, and reducing pollution from stop-and-go traffic. Moreover, because of network equilibration and the Mogridge-Lewis convergence phenomenon, reliable transit service supported by FAIR Highway Network revenues will lead to reduced auto travel times in all congested corridors, both on the freeway as well as on arterials. The value of travel time saved by peak period solo drivers will exceed by far the relatively small peak service charges that they will pay. Off peak drivers, previously subjected to the after effects of traffic flow breakdowns during peak hours, will receive travel time savings for free.

Some highway user groups have expressed a concern that toll revenues should not be diverted away from what the driver is paying for – new road capacity. However, new road capacity becomes available to a motorist in peak periods each time another driver is diverted away from solo driving and into a carpool or a transit vehicle. In many cases, it can be less expensive and more cost-efficient to provide public support for peak period ridesharing and transit service than to provide highway service for solo-drivers. For example, at an average public cost of 32 cents per mile for a new peak-period vehicle trip (12), the average public cost for a new 10-mile solo-driver commute trip is $3.20. Carpooling and transit use can reduce these public costs by dividing them among more commuters; the public cost savings could justifiably be used to support these modes. Auto clubs in the New York metropolitan area understand these benefits and support the use of highway user fees for transit.

Taxpayer interests: FAIR Highway Networks will not need public subsidies and may in fact provide new funds to expand multimodal transportation capacity where demand or market clearing price suggest it is needed. Unlike the Poole-Orski HOT networks proposal, tax dollars will not be needed, and private sector provision of services will be facilitated, making service delivery more efficient and more effective. FAIR Highway Networks can increase private sector participation in provision of traditional government services.

Transportation industry interests: Transportation builders are likely to appreciate the new funding that will flow from peak charges, which will allow expansion of transportation capacity where needed. Initially, builders will benefit from projects for construction of park-and-ride facilities and access ramps. After revenues start coming in, surpluses will be available to support infrastructure expansion to accommodate growth in population, employment and travel and maintain high levels of mobility and access for all. The ITS industry and tolling industry will benefit from contracts for technology services and electronic toll collection equipment installation and operations.

Environmental interests: FAIR Highway Networks will increase travel choices. Revenue will be generated to pay for new transportation choices such as new express bus services, park-and-ride lots for carpoolers and other improvements to benefit pedestrian and bicycle modes. Also, unlike the HOT networks proposed by Poole and Orski, two-person carpools will be able provided with premium service on the freeway for free, preserving and enhancing a privilege now available to carpoolers in many metropolitan areas, and increasing equity and travel choices. Due to enhancement of transit opportunities, a FAIR Highway Network will promote livability and accessibility, and reduce auto-dependence. Jonathan Levine (13) posits that simply investing in highway improvements may discourage transit use, due to re-location of activities to more distant locations to take advantage of lower land costs. While the highway improvement may increase mobility, i.e., result in shorter travel time per mile, it may end up reducing accessibility, i.e., result in more time to get to a more distant destination. On the other hand, improved or new transit service, as proposed with FAIR Highway Networks, encourages business and residential activity to locate near transit stations at higher densities. When destinations are brought close to one another, *mobility* may be reduced, i.e., it may take more time *per mile* to access them by transit or walking, but *accessibility* will be higher, i.e., less total time will be needed to get to a destination, due to proximity.

7.0 DEMONSTRATION OF THE CONCEPT

Despite the potential appeal of a FAIR Highway Network, it may be difficult to get public acceptance due to complexity of the scheme, public mistrust of government, and the difficulty in explaining concepts such as the freeway congestion paradox to the public. Public trust, understanding and acceptance of the strategy may be facilitated with a small-scale pilot project to demonstrate the concept.

The concept may be demonstrated on I-66 inside the Capital Beltway in Washington, DC. The facility is currently restricted to HOV2+ vehicles in peak hours. HOV occupancy requirements could be raised back to the original HOV3+ requirement, and HOV2 and SOV use could be permitted with payment of a peak service charge set high enough to ensure free flow of traffic. Revenues may be dedicated to improve or further subsidize transit service in the corridor.

When the public realizes, through a pilot implementation project, how much of a difference FAIR Highway Networks can make to congestion, mobility, transportation choices, air quality and livability, it may be easier to expand the concept to the entire metropolitan network. Expansion to the network may be executed in stages, although this might reduce the viability of the transit system. The most congested corridors would be the prime candidates. The FAIR Highway Network concept does not have to be implemented in *every* existing congested corridor in order to be effective. For example, if the Capital Beltway in Northern Virginia between the Woodrow Wilson Bridge and Tyson's Corner to the west is priced in peak periods, this is likely to reduce traffic volumes and congestion on the bridge itself, as well as on freeway segments to the east in Maryland.

8.0 SUMMARY AND CONCLUSIONS

A FAIR Highway Network may provide significant net social benefits and also generate sufficient new revenues to pay for arterial network and freeway network management and operations (including toll collection) as well as the new express bus service and ancillary park-and-ride facilities. Surpluses may also be available to address new transportation capacity needs in growing areas. While public acceptability is a major hurdle, it is conceivable that FAIR Highway Networks can gain support from stakeholders and political leaders if its benefits are carefully explained, and if a pilot project is implemented to demonstrate its effectiveness and operational feasibility.

Disclaimer: The views expressed are those of the authors and not necessarily those of the U.S. Department of Transportation or the Federal Highway Administration.

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